

REMARKS

Applicants respectfully request favorable reconsideration of this application, as amended.

By this Amendment, Claims 15-16 have been cancelled for presentation in a continuation application to be filed shortly. New dependent Claims 40-48 have been added, and non-elected Claims 22-39 have been cancelled without prejudice or disclaimer in order to avoid additional fees for the presentation of Claims 40-48. Applicants reserve the right to file one or more divisional applications with respect to Claims 22-39. In view of the aforementioned claim additions and cancellations, Claims 1-14, 17-21, and 40-48 are pending.

Referring initially to independent Claim 1, the language has been amended to clarify the subject matter intended to be claimed. As amended, Claim 1 recites a semiconductor device comprising a semiconductor substrate, a first insulating film formed over the semiconductor substrate, a wiring opening formed in the first insulating film, and a wiring having a first conductive film containing copper as a primary component and embedded in the wiring opening. Additionally, the device includes a first barrier insulating film formed over the wiring and the first insulating film, a second barrier insulating film formed

over the first barrier insulating film, and a second insulating film formed on said second barrier insulating film and having a lower dielectric constant than that of an oxide silicon film.

In accordance with the invention, a barrier property of a material constituting the first barrier insulating film to copper is larger than that of a material constituting the second barrier insulating film. Further, the material constituting the second barrier insulating film has a greater adhesiveness than the material constituting the first barrier insulating film to a material constituting the second insulating film.

Claim 1 was initially rejected as being obvious over Lee (US 2003/0008493) in view of Ko (US 2004/0067658). At least as presently amended, however, Claim 1 distinguishes patentably from the applied references.

Lee teaches a semiconductor device in which an adhesion layer 260 and a sealing layer 270 are formed, in that order, over a copper wiring 240. An insulating layer 280, which may be a low-k material, is formed on the sealing layer 270. Notably, Lee discloses a number of candidate materials for the adhesion and sealing layers, and does not disclose a specific material of the insulating layer 280.

It is apparent that, in contrast to Applicants' invention, Lee contemplates the primary copper barrier function as being provided by the sealing layer 270. In Applicants' invention, on the other hand, as between the first and second barrier insulating films, it is the first barrier insulating film which has the greater barrier property to copper.

Further still, Lee does not teach or suggest the claimed feature wherein the material of the second barrier insulating film has a greater adhesiveness than the material of the first barrier insulating film to a material of the second insulating film. As noted above, Lee teaches a number of candidate materials for his adhesive and sealing layers 260, 270 and teaches no particular material of the insulating layer 280. As such, Lee does not teach or suggest a particular combination of materials as would be required to achieve the claimed barrier and material adhesiveness relationships.

Ko's cited teaching of a low-k insulating film 34 fails to overcome the aforementioned deficiencies of Lee vis-à-vis Applicants' invention as set forth in Claim 1. It should be noted, further, that Ko's layer 34 sits atop layers 32 and 30, which are an anti-reflection layer and an etch stop

layer, respectively, and which are quite remote from the copper wiring 22.

The additional teachings of Hironaga et al. (U.S. 2003/01703671), cited in connection with dependent Claim 9, also fail to overcome the fundamental deficiencies of Lee and Ko discussed above.

Accordingly, Claim 1 and its dependents should now be allowed.

As will be evident, each of independent Claims 13 and 17 has been amended to recite barrier and adhesiveness properties analogous to those set forth in Claim 1. Thus, Claims 13 and 17, and their respective dependents, are also patentable over the applied references. Note also that Claim 17 has been amended to eliminate the alleged recitations of intended use.


In view of the amendments and arguments presented herein, Applicants respectfully solicit an early Notice of Allowance.

The Commissioner is hereby authorized to charge to Deposit Account No. 50-1165 any fees under 37 C.F.R. §§ 1.16 and 1.17 that may be required by this paper and to credit any overpayment to that Account. If any extension of time is required in connection with the filing of this paper and

has not been requested separately, such extension is hereby requested.

Respectfully submitted,

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